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The products in both cases are the tailed locomotive forms, which are, according to all observers, probably true single cells, which, from the earliest period of their discovery, have been compared or identified with the locomotive monads, the products of the encysted stage in many of the Protozoa.

The essential difference between a spermatocyst and its homologue among Protozoöa consists in the fact that the latter has to become a full-grown feeding zoön before it is ripe, and proceeds to produce by division secondary males, which seek out the female for the purposes of impregnation, while the latter, as its descendant, has acquired by concentration of development, the same powers and habits in its earliest stage, and its sole function is to become encysted and produce larval male cells for the impregnation of the female zoön or ovum. The impregnation in both cases immediately precedes the reorganization of the nucleus of the female (ex. *Vorticella*), and are followed by a period of reproduction by division, which is infinitely more concentrated in the encysted ovum, as an encysted larval form, than in the free adult Protozoön. The former is thus a builder of close-set tissues composed of larval cells, and the latter of loosely associated colonies of adult feeding zoöns.

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## THE NATURALIST BRAZILIAN EXPEDITION.

### PAPER III.—SÃO JOÃO DO MONTE NEGRO.

BY HERBERT H. SMITH.

(*Continued from page 1014, October number, 1883.*)

ABOUT the middle of February we changed our residence to the village of São João do Monte Negro, which lies on the Rio Cahy, a northern branch of the Guahyba. Small steamboats run up this river from Porto Alegre nearly every day, touching at the various German colonies along the banks, and bringing down mandioca-meal, corn, beans, tobacco and other products.

The Cahy is very crooked, and the lower portion is bordered by a wide flood-plain. The clay banks are steeply cut, and often thirty feet high, so as to be beyond reach of all except the strongest floods. They are covered in many places with heavy forest, leguminous trees and myrtles being abundant; the branches are draped with vines, and palms of one or two kinds are often

seen, so that the scenery reminded us much of river-shores in equatorial Brazil.

Twenty-five miles in a direct north-west line from Porto Alegre, but fifty as the river runs, the flood-plain is greatly narrowed, and picturesque hills appear on either side; these are out-lyers and denuded portions of the table-land farther north; near São João none of them exceed 800 feet in height. The village itself lies on a higher portion of the flood-plain, at the foot of one of the hills; only a few of the houses and the Catholic church are on a spur of the highlands. The Cahy being subject to heavy floods, the streets are often overflowed, and once or twice a year the houses are invaded; for this reason many of them have an upper story to which the inmates can retire when the ground floor is covered with water. Notwithstanding these frequent inundations the place is notably healthy, malarial fevers being quite unknown; colds and lung diseases are occasionally prevalent, but only during the cold weather. Nearly all the people of São João are Germans, and the German language is much more frequently used than the Portuguese; there is a German Lutheran church, and a German school where many of the children appear in the characteristic peasant costumes of the Fatherland. But for the whitewashed and tile-roofed houses scattered irregularly along the unpaved streets, and the semi-tropical scenery around the place, one might fancy that São João was a country village in Germany.

We resided at first with some German friends, but after a few days we hired a house, arranging to have our meals brought in from a neighboring hotel. Here we lived quietly for several months, making very extensive collections of the animals and plants of the surrounding country. The colonists soon learned that we paid good prices for any animal which they brought us, and even for snakes and insects, and some of them came nearly every day with specimens to sell; in this way we secured many rare species. After awhile we hired two young Germans as hunters and general servants, and these afterwards accompanied us in our travels. Our house resembled a laboratory; we had improvised rough board tables and shelves for our work, and they were generally crowded with jars of snakes and fishes, boxes of insects, botanical presses and so on. An outhouse which had been built for a kitchen was used for rougher operations, such as skin-

ning large animals and boiling and cleaning bones. Our daily life was varied only with new excursions, or with those pleasant excitements which attend the discovery of some rare species or interesting fact. Yet it would be hard to imagine a more agreeable existence than that which we led; our house was a real home to us, and our warm-hearted German neighbors became fast friends; in the end we were very sorry to leave them.

The country around São João is properly a forest region, but this varies much in its characters. On the hillsides it is very heavy, averaging eighty feet in height; the trees and plants, in the main, are of the same species as those found at Rio de Janeiro and in the Brazilian coast range. I noticed only two kinds of palms (a *Cocos*? and a large, spiny *Bactris*, the latter growing only in swampy places); woody climbers are numerous, and there is much underbrush. Ravines and water-courses are so matted over with bushes and vines that one may often walk on top of the vegetation, several feet above the ground.

The river shores and higher portions of the flood-plain have a vegetation which resembles that of the hillsides, but many of the trees are of different species, and they are generally more spreading in their growth, the branches being covered with parasites and trailing lichens; there is comparatively little undergrowth, and one may walk readily almost anywhere without cutting a path. Probably this paucity of smaller plants is owing to the periodical floods, which are unfavorable to them. Most of the herbs which cover the ground in such places are annuals.

A third kind of forest is the *fachinal*, or "faggot-woods," found on dry, sandy soil, generally rather low land, but above the limits of the highest floods. It is composed of low, gnarled trees, either a continuous wood or forming clumps in open ground. They are tangled but not dense, and the ground beneath is covered with grass and dry ferns. Nearly all the plants of the *Matto fachinal* are distinct from those of the hillsides and alluvial plains, and where the *fachinal* adjoins other forest the limits are always well marked. In their general features these low woods reminded me of those seen in the interior of Brazil, back of the coast range; probably they may be considered as outlying portions of the latter.

Lower parts of the alluvial plain are occupied by meadows, which are often swampy or half flooded; they form excellent

pastures, though the horses and cattle are often obliged to pass many days with their feet in the water. The flowering herbs of these meadows were very interesting; but botanizing on them and in the fachinal forest was rendered difficult by spiny bromelias, which covered the ground in many places. Ditches lined with these plants were generally used by the colonists in lieu of fences.

To the north of São João the fachinal and meadows disappear almost entirely, and the whole country is covered with lofty forest. This is continuous with that which clothes the whole coast range, but on the northern table-land it is broken by large tracts of grass-land.

Passing south-west from São João, about three miles, the forest all at once disappears, giving place to rolling prairie like that which we saw at São Jeronymo. The change is very sudden and striking, and coming as it does unexpectedly, the effect is almost magical. Riding out of the silent woods, a new world leaps into view; a world of great open landscapes, of rippling light, of glorious sweeping winds; a world where every animal and every plant is different from those of the forest which we left behind. So far as the fauna and flora go, this is, in fact, the end of Brazil. From this point the prairies extend, with hardly a break, away to the Rio de la Plata, and beyond it almost to Cape Horn. Only in a few favored places the forest reappears in small patches, Brazilian islands in the pampean ocean.

The geology of the São João district is rather uninteresting. The hills to the north and west of the village are composed of soft, friable, reddish-brown sandstone, which by intrusions of basaltic and other igneous rocks has been thrown into irregular flexures. The lower portions are soft and often shaly, and as they are more readily washed away the harder upper layers are left in picturesque cliffs. These sandstones and sandy shales show a section of at least 800 feet, and probably they are much thicker. On the Serra de São João, near the village and elsewhere, the harder upper layers are quarried, the stone being used in Porto Alegre for sidewalks and for facings; it is, however, too soft to be of much value.

In this hill the strata dip north-east at an angle of about  $15^{\circ}$ ; elsewhere they present almost every possible strike and inclination. From information which I have, it would appear that the

same sandstone extends northward almost to the limits of Santa Catharina. From the position of the beds there can be little doubt that they lie above the coal rocks of São Jeronymo, but beyond this I know nothing of their age. Careful search was made for fossils but without success.

The Monte Negro is a singular cliff-crowned hill about 800 feet high, lying near the river-shore about two miles south of the village; it derives its name from the somber color of its forest-covered sides when seen against the open campos. This hill is composed of a singular dark porphyritic rock, originally an eruptive mass which cut through the sandstone; by the denudation of the latter it has been left standing like a tower, the upper part rising perpendicularly, while the base, covered with talus, slopes away steeply to the plain. Other hills in the vicinity are formed of the same rock, or of basalt; where these occur in low, damp places the decomposition has sometimes given rise to agates like those of São Jeronymo.

The flora of the country around São João is exceedingly rich. My wife, to whom the botanical collections were relegated, devoted herself especially to ferns, gathering no less than 135 distinct species.<sup>1</sup> Among these were four or five tree-ferns, and many very large brakes. The fachinal forest contained a peculiar set of dry, stiff-looking species; others grew on the branches and trunks of trees and in shady ravines. But by far the richest collecting places were the sandstone cliffs. Where streams fell over these they often presented magnificent pictures, great tree-ferns mingling with giant brakes, and lesser species carpeting the rocks or hanging in fairy curtains from some projecting ledge. Many of the species take root at the ends, and we found one true "walking-fern," which was regularly propagated in this way.

The settlers speak of over fifty kinds of excellent timber in the forest, and there are probably three times as many less valuable species. I made a collection of about seventy-five kinds, many of which were equal in beauty to the finest cabinet woods used in the United States. With the present increasing taste for all ornamental work, it is hardly possible that these fine Brazilian woods should be long neglected.

Our collections, both of vertebrates and invertebrates, were

<sup>1</sup> Two hundred and fifty species have been collected at Rio de Janeiro, probably more than at any other one point in the world.

very large, but I will speak here only of the Mammalia. Of monkeys I heard of only four kinds, three of which we secured. The largest and commonest is a howler, called here *bugiu*;<sup>1</sup> it varies in color from a very dark reddish-brown to a bright red or almost ochre; the light-colored specimens are always the older ones. The largest individual which we obtained was an old male which measured just two feet from the nostril to the root of the tail, the tail itself being twenty-five inches long; the girth was fifteen and a-quarter inches. The bugius wander in considerable bands, nearly always among the branches, but occasionally on the ground; they eat the fruits of forest trees, and perhaps birds' eggs and insects. The females commonly have two young at a birth, and these, when traveling, cling to the long hair at the back of the mother's neck; when sucking they are generally seated on a branch before her. This species wanders only in the daytime, sleeping on boughs at night.<sup>2</sup> The peculiar bony enlargement of the larynx, by which the hoarse cry or howl is produced, is fully developed only in the males, the females being nearly dumb. When traveling the males of this Rio Grande species are also silent; the emission of the cry is accompanied by a kind of dance in which the whole tribe takes part. This occurs sometimes during the day, sometimes at twilight, but in any case the figure of the dance is the same. The males leap rapidly, from branch to branch, in a circular direction, generally by following the outer boughs of some large tree; the females form a larger circle around the males. While moving the males give forth their peculiar cry, and the whole troop appear to be much excited; the performance may last half an hour.

The howlers, it is said, can never be thoroughly tamed; in captivity they are morose and treacherous, often biting severely. There is a black *Ateles* found in the same forest, but much less commonly than the bugiu; of its habits in a wild state I know nothing, but tame individuals are sometimes seen, and these are very gentle and intelligent. Young ones have a curious resemblance to human babies, amusing themselves with bits of straw or sticks, and moving their long arms helplessly; when scolded or struck they give vent to doleful cries, but never attempt to

<sup>1</sup> *Guariba* on the Amazons.

<sup>2</sup> One of the Amazonian species certainly wanders during the night. More than once, when camping near Santarem, I have been awakened by the howlers which passed overhead with their usual hoarse cry.

scratch or bite. They are very fond of caresses, and will lie quite still to receive them, crooning a little in a ridiculously satisfied way. I knew a tame *Ateles* of another species which always met one with an embrace around the neck ; this was not an acquired trick, but simply the natural expression of its affection for human beings.

One individual of a large *Cebus* was brought in ; it was a great rarity, and none of our hunters recognized it at all. There is a smaller monkey occasionally seen here, which I judge to be also a *Cebus*, but we did not obtain specimens. The marmosets do not seem to be represented, at least in the eastern part of this province.

Bats were rather common, but by no means as numerous as in equatorial Brazil, and none of the species which we obtained were very large. So far as I could discover, the blood-sucking kinds are unknown here.

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## THE EXHALATION OF OZONE BY FLOWERING PLANTS.

BY J. M. ANDERS, M.D., PH.D.

(*Continued from page 344.*)

IT became evident that in order that this important question might be set at rest, the conditions would have to be varied and further observations instituted. I now set to work to devise the necessary apparatus to carry on such experiments. Accordingly I had made a glass case large enough to contain a dozen or more thrifty growing plants in pots. Its dimensions were as follows : length, three and a half feet ; width, two and a half feet, and height, two and a half feet. A portion of the top was left removable, so as to furnish an aperture through which the plants could be placed in the case and again taken out. Such an arrangement as this would admit the sunlight to the plants and confine their exhalations, and thus give the ozone, if any should be generated, a better opportunity of acting upon the test papers. In all of the remaining experiments here recorded I was greatly assisted by Mr. G. B. M. Miller, my medical student. The apparatus was first placed in the bay window of an occupied sitting-room facing east. The plants here received the sun's rays for at least six hours of the day. A dozen thrifty plants were placed in the